

WHAT IS CLAIMED IS

1 1. A microfabricated fluidic amplifier device, comprising:

2 an elastomer block formed with an input chamber and an output chamber, that
3 amplifies the pressure in the output chamber relative to the input chamber, wherein fluid in
4 the input chamber is isolated from fluid in the output chamber.

1 2. The microfabricated fluidic amplifier device of claim 1 wherein the
2 input chamber is formed in a first elastomer layer and the output chamber is formed in a
3 second elastomer layer.

1 3. The microfabricated fluidic amplifier device of claim 2 wherein the
2 second elastomer layer further comprises a third chamber at least partially surrounding the
3 output chamber.

1 4. The microfabricated fluidic amplifier device of claim 3 wherein the
2 third chamber is filled with a fluid at ambient pressure.

1 5. The microfabricated fluidic amplifier device of claim 2 wherein the
2 first elastomer layer comprises a rigid material in the input chamber above the output
3 chamber.

1 6. The microfabricated fluidic amplifier device of claim 1 wherein the
2 amplifier device is configured to perform integration.

1 7. The microfabricated fluidic amplifier device of claim 1 wherein the
2 amplifier device is configured to perform differentiation.

1 8. A microfabricated fluidic switch, comprising:

2 an elastomer block formed with a gate channel and a drain-to-source channel,
3 that closes and opens the drain-to-source channel in response to pressure changes in the gate
4 channel,

5 wherein pressure in the gate channel does not need to be increased above, or
6 decreased below pressure in the drain-to-source channel.

1 9. The microfabricated fluidic switch of claim 8 wherein the gate channel
2 is formed in a first elastomer layer and the drain-to-source channel is formed in a second
3 elastomer layer.

1 10. The microfabricated fluidic switch of claim 9 wherein a rigid material
2 is formed on the second elastomer layer in the gate channel.

1 11. The microfabricated fluidic switch of claim 9 wherein a first chamber
2 is formed in the second elastomer layer adjacent to the drain-to-source channel.

1 12. The microfabricated fluidic switch of claim 11 wherein a second
2 chamber is formed in the second elastomer layer adjacent to the drain-to-source channel.

1 13. The microfabricated fluidic switch of claim 9 wherein a first chamber
2 is formed in the first elastomer layer adjacent to the gate channel.

1 14. The microfabricated fluidic switch of claim 13 wherein a second
2 chamber is formed in the second elastomer layer adjacent to the drain-to-source channel.

1 15. The microfluidic switch of claim 8 wherein the switch is a pressure
2 actuated normally open switch.

1 16. The microfluidic switch of claim 8 wherein the switch is a pressure
2 actuated normally closed switch.

1 17. The microfluidic switch of claim 8 wherein the switch is a vacuum
2 actuated normally open switch.

1 18. The microfluidic switch of claim 8 wherein the switch is a vacuum
2 actuated normally closed switch.

1 19. A microfabricated fluidic logic device, comprising:
2 an input channel and an output channel; and
3 a first microfabricated fluidic switch, wherein the microfabricated fluidic logic
4 device performs a logic function on an input signal in the input channel to provide an output
5 signal in the output channel.

1 20. The microfabricated fluidic logic device of claim 19 wherein the
2 output signal is the inverse of the input signal.

1 21. The microfabricated fluidic logic device of claim 19 wherein the
2 microfabricated fluidic logic device is an OR gate.

1 22. The microfabricated fluidic logic device of claim 19 wherein the
2 microfabricated fluidic logic device is a NOR gate.

1 23. The microfabricated fluidic logic device of claim 19 wherein the
2 microfabricated fluidic logic device is a AND gate.

1 24. The microfabricated fluidic logic device of claim 19 wherein the
2 microfabricated fluidic logic device is a NAND gate.

1 25. The microfabricated fluidic logic device of claim 19 wherein the
2 microfabricated fluidic logic device is a flip-flop.

1 26. The microfabricated fluidic logic device of claim 25 wherein the flip-
2 flop comprises first and second cross-coupled NAND gates.

1 27. The microfabricated fluidic logic device of claim 26 wherein each of
2 the two NAND gates comprises two pressure actuated normally open switches coupled in
3 parallel.

1 28. The microfabricated fluidic logic device of claim 25 wherein the flip-
2 flop comprises first and second cross-coupled NOR gates.

1 29. The microfabricated fluidic logic device of claim 28 wherein the two
2 NOR gates comprise two pressure actuated normally open switches coupled in series.

1 30. The microfabricated fluidic logic device of claim 28 further
2 comprising:
3 first and second step pressure sources coupled to the flip-flop;
4 a second microfabricated fluidic switch coupled between the first step pressure
5 source and the first NOR gate;

6 a third microfabricated fluidic switch coupled between the second step
7 pressure source and the second NOR gate.

1 31. The microfabricated fluidic logic device of claim 28 further
2 comprising:

3 a step pressure source comprising an output coupled to the flip-flop through
4 second and third microfabricated fluidic switches; and

5 fourth and fifth microfabricated fluidic switches, each coupled between the
6 output of the step pressure source and ambient exhaust.

1 32. The microfabricated fluidic logic device of claim 31 further
2 comprising:

3 a first microfabricated fluidic capacitor coupled to an input of the first NOR
4 gate and the gate of the fourth switch;

5 a second microfabricated fluidic capacitor coupled to an input of the second
6 NOR gate and the gate of the fifth switch;

7 a first fluidic resistor coupled to the first capacitor; and
8 a second fluidic resistor coupled to the second capacitor.

1 33. The microfabricated fluidic logic device of claim 28 further
2 comprising:

3 a step pressure source comprising an output coupled to the flip-flop through
4 second and third microfabricated fluidic switches; and

5 a fourth microfabricated fluidic switch coupled between the output of the step
6 pressure source and ambient exhaust, wherein the gate of the fourth switch is coupled to a
7 clock signal.

1 34. The microfabricated fluidic logic device of claim 19 wherein the
2 switch comprises a pressure actuated normally open switch.

1 35. A microfabricated fluidic pressure source, comprising:

2 a fluidic pump;

3 microfabricated fluidic first and second unidirectional valves, each coupled to
4 the pump; and

5 a microfabricated fluidic reservoir coupled to the second unidirectional valve.

1 36. The microfabricated fluidic pressure source of claim 35 wherein the
2 pump comprises an elastomeric region with an internal chamber.

1 37. The microfluidic pressure source of claim 35 wherein fluid is forced
2 through the second unidirectional valve into the reservoir when the pump is compressed or
3 bent.

1 38 . The microfluidic pressure source of claim 35 wherein at least one of
2 the unidirectional valves comprises a channel in a region of elastomer material, an elastomer
3 flap, and a stopper in the channel, wherein the stopper prevents the flap from opening the
4 channel when fluid flows in a first direction through the channel, but not in a second
5 direction.

1 39. The microfluidic pressure source of claim 35 wherein the reservoir
2 comprises a chamber inside a plurality of elastomeric layers.

1 40. The microfluidic pressure source of claim 39 wherein an elastomer
2 layer above the chamber flexes as the pressure inside the chamber changes.

1 41. The microfluidic pressure source of claim 35 wherein the microfluidic
2 pressure source is a high pressure source.

1 42. The microfluidic pressure source of claim 41 wherein at least one of
2 the unidirectional valves comprises a microfabricated fluidic pressure multiplier coupled to a
3 pressure actuated normally closed switch.

1 43. The microfluidic pressure source of claim 35 wherein the microfluidic
2 pressure source is a vacuum pressure source.

1 44. The microfluidic pressure source of claim 43 wherein at least one of
2 the unidirectional valves comprises a microfabricated fluidic pressure multiplier coupled to a
3 vacuum actuated normally closed switch.

1 45. The microfluidic pressure source of claim 35 wherein the microfluidic
2 pressure source further comprises:

3 a third unidirectional valve coupled to the second unidirectional valve;
4 a fourth unidirectional valve coupled to the third unidirectional;

5 a first microfluidic capacitor coupled between the pump and the third
6 unidirectional valve; and

7 a second microfluidic capacitor coupled between the third and the fourth
8 unidirectional valves.

1 46. The microfluidic pressure source of claim 35 wherein at least one of
2 the unidirectional valves comprises:

3 first and second elastomer layers with a first channel there between;
4 an elastomer spacer in the first channel that is sealed to the first elastomer
5 layer; and

6 an elastomer flap sealed to the spacer, but not sealed to the second elastomer
7 layer which covers a feed through channel in the second elastomer layer.

1 47. A microfabricated fluidic switching regulator, comprising:
2 a microfabricated fluidic pressure multiplier; and
3 a microfabricated fluidic switch coupled to an output of the pressure
4 multiplier.

1 48. The microfabricated fluidic switching regulator of claim 47 wherein the
2 switch is a pressure actuated normally closed switch.

1 49. The microfabricated fluidic switching regulator of claim 47 wherein
2 the pressure multiplier has a first input terminal coupled to a high pressure source, and a
3 second input terminal coupled to ambient exhaust.

1 50. A microfabricated fluidic capacitor comprising:
2 a first elastomer layer comprising a first chamber,
3 a second elastomer layer comprising a second chamber adjacent to the first
4 chamber, and wherein the first and second chambers there is no fluid flow between the first
5 and second chambers.

1 51. A microfabricated fluidic unidirectional valve, comprising:
2 a microfabricated fluidic pressure amplifier coupled between an input terminal
3 and an output terminal; and
4 a microfabricated fluidic switch coupled to an output of the pressure
5 multiplier.

1 52. A microfabricated fluidic unidirectional valve, comprising:
2 microfabricated elastomer material that has a flow through channel; and
3 an elastomer flap attached to the elastomer material in the flow through
4 channel that forms a seal in the flow through channel to prevent fluid from flowing in a first
5 direction through the flow through channel, and to allow fluid flow in a second direction
6 through the flow through channel.

1 53. The microfabricated fluidic unidirectional valve of claim 52, wherein
2 the elastomer material comprises a stopper in the flow through channel that forms a seal with
3 the elastomer flap when fluid flows in the first direction.

1 54. A microfabricated fluidic device, comprising:
2 a plurality of input channels and an output channel; and
3 a first microfabricated fluidic switch, wherein the microfabricated fluidic
4 device performs a mathematical function on analog input signals in the input channels to
5 provide an analog output signal in the output channel.

1 55. The microfabricated fluidic device of claim 54 wherein the
2 microfabricated fluidic device performs addition on the input signals to provide the output
3 signals.

1 56. The microfabricated fluidic device of claim 54 wherein the
2 microfabricated fluidic device performs subtraction on the input signals to provide the
3 output signals.

1 57. The microfabricated fluidic device of claim 54 wherein the
2 microfabricated fluidic device performs multiplication on the input signals to provide the
3 output signals.

1 58. The microfabricated fluidic device of claim 54 wherein the
2 microfabricated fluidic device performs division on the input signals to provide the output
3 signals.